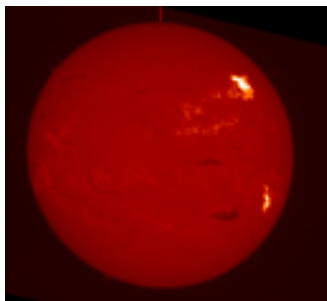
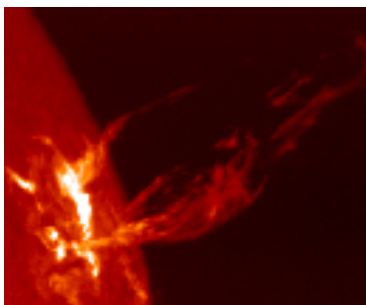


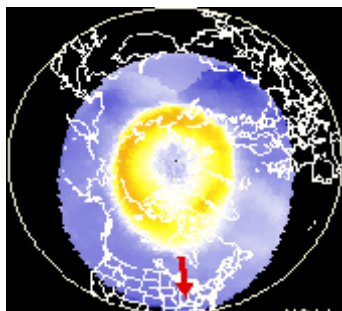
Solar events cause space weather



Two flaring regions on the sun



A solar flare with eruptive prominence near the limb of the sun



Satellite image of aurora

# Space Environment Center

## Space Weather services and research

### What does the Space Environment Center do for the nation?

The Space Environment Center (SEC) is the Nation's official source of space weather alerts and warnings. SEC continually monitors and forecasts Earth's space environment; provides accurate, reliable, and useful solar-terrestrial information; and leads programs to improve services. SEC conducts research into phenomena affecting the Sun-Earth environment, including the emission of electromagnetic radiation and particles from the Sun, the transmission of solar energy to Earth via solar wind, and the interactions between the solar wind and Earth's magnetic field, ionosphere, and atmosphere.

The role of the Space Environment Center is to gather the available data that describe the space environment, to synthesize an assessment of current conditions, and to create forecasts of future conditions. When events warrant, warnings and alerts are issued for systems operators who may be adversely affected by space weather storms. These user groups are private, commercial, government, and military operators, concerned with electric power distribution, high-frequency radio communications, satellite operations, astronaut protection, radio navigation, and national security.

### Recent Accomplishments:

- Approximately two years ago, introduced physics-based numerical models, for the first time, into the operational space weather service. It was possible to use these university-developed models only when realtime solar wind data from upstream of Earth became available to drive them. ***Payoffs: Now forecasters get numerical guidance, much as meteorological forecasters do. Also, numerical models suggest paths for improvements in the accuracy and lead times of forecasts. Finally, model output can be disseminated to provide customers with the space weather analogs of meteorological weather maps, showing event locations and intensities of computed fronts and boundaries.***
- Developed partnerships to bring to Boulder, put to use in operations, and disseminate via the World Wide Web data obtained with sensors aboard NASA research spacecraft. Won a reinventing government Hammer Award from Vice President Gore for this work. Partners were enlisted, at very little or no cost to NOAA, from Japan, United Kingdom, India, France, the U.S. Air Force, and NASA to keep a continuously transmitting spacecraft in continuous view from their tracking stations around the world, then using the Internet to bring the data cheaply to Boulder. ***Payoffs: Very inexpensively, the data are available to aid forecasters, to drive the space weather models, and to inform the public (including the NASA experimenters) immediately. Also, the huge expense of the research satellites brings added benefit to taxpayers because the data improve specification and forecast of the space environment.***
- Improved a Web site to get space weather information to interested users. ***Payoffs: Information is conveyed, quickly, accurately, and cheaply to a multitude of users. (There were about 1.5 million file transfers from the Web site during each of two consecutive 24-hour periods during solar and geomagnetic activity in July 2000.) Educators and media representatives can find on the site much valuable information and explanations of space weather physics and effects, in addition to data.***

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## What's Next for SEC?

Science Challenges in the next 5-10 years:

- Improving and assimilating data, distributed in space and time, into updating numerical models is one of the biggest challenges, as it has been for the meteorological sciences community. The challenge combines computational science and physical understanding of the space environment, and will lead to improvements in both. With successful "4-D data assimilation", the model outputs – the space weather maps – will be more accurate and more skillful, therefore more useful to users of the services.
- A solar x-ray imager, to be launched on GOES-M in 2001, and funded as a USAF-NASA-NOAA partnership, will provide images of the solar corona at a rate of one per minute. Research with images from its less-capable predecessors implies that visible coronal changes will signal events on the Sun which will later cause space weather storms and may signal these events well in advance. Automating the extraction of information from these images and determining how to incorporate the information into specification and forecast algorithms is a rich challenge which will shed light in a new way on solar processes responsible for the solar wind and eruption events hazarding Earth.

## Research Partnerships:

SEC works closely with colleagues in universities and national laboratories, in the U.S. and internationally, to understand the space environment and to capture that understanding in physics-based numerical models. The seven-agency National Space Weather Program's Implementation Plan (revised in 2000) sets out the expected data, research, and services contribution from each participating agency.

Cooperative ventures abound in SEC as graduate students, post-doctoral students, visiting scientists, Cooperative Institute fellows from the University of Colorado, and contractors all contribute to the effort at the Center. Additionally, SEC works with the Cooperative Institute for Research in Environmental Sciences, a NOAA joint institute.

## Services Partnerships:

To provide its specification and forecast services, SEC works most closely with the U.S. Air Force Weather Agency's forecast centers in Colorado Springs and Omaha, which provide services to U.S. military customers. NOAA civilians and uniformed NOAA Corps and U.S. Air Force personnel jointly operate SEC's Space Weather Operations. SEC has one active Cooperative Research and Development Agreement, with Federal Data Corporation (FDC), to develop a model of the wavelength-dependent changing solar brightness, for customers interested in ionospheric changes and heating of the terrestrial atmosphere.

## Budget and Staff:

SEC is a \$6 million lab (\$5.4 million in NOAA base) with 65 employees, including federal, university, and contract employees. SEC is also one of the National Weather Service's National Centers for Environmental Prediction.



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